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CLAIMS

[Claim(s)]

[Claim 1] The first substrate in which the pixel electrode was formed in the pixel which arranges a signal line and the scanning line in the shape of a matrix, and is surrounded with said signal line and said scanning line, The second substrate in which the common electrode was formed, and the orientation film which performed perpendicular orientation processing by which a laminating is carried out on said both substrates, In the liquid crystal display which a liquid crystal molecule inclines and is arranged when the dielectric constant anisotropy pinched among said both substrates had the negative liquid crystal layer, a liquid crystal molecule carries out a perpendicular array when electric field are not impressed to said liquid crystal layer, and electric field are impressed to said liquid crystal layer The liquid crystal display characterized by having the projection of the conductor which is prepared in said second substrate and regulates the inclination direction of said liquid crystal molecule, said projection of said pixel electrode, and the slit formed in the part which counters.

[Claim 2] The liquid crystal display according to claim 1 characterized by establishing a means to supply said common electrode and same electric potential to said projection.

[Claim 3] Said projection is a liquid crystal display according to claim 2 characterized by extending continuously and connecting with said common electrode electrically at said edge to the edge of said second substrate.

[Claim 4] The first substrate in which the pixel electrode was formed in the pixel which arranges a signal line and the scanning line in the shape of a matrix, and is surrounded with said signal line and said scanning line, The second substrate in which the common electrode was formed, and the orientation film which performed perpendicular orientation processing by which a laminating is carried out on said both substrates, In the liquid crystal display which a liquid crystal molecule inclines and is arranged when the dielectric constant anisotropy pinched among said both substrates had the negative liquid crystal layer, a liquid crystal molecule carries out a perpendicular array when electric field are not impressed to said liquid crystal layer, and electric field are impressed to said liquid crystal layer The projection which is prepared in said second substrate and regulates the inclination direction of said liquid crystal molecule, It is the liquid crystal display characterized by having said projection of said pixel electrode, and the slit formed in the part which counters, and forming said projection with the dielectric which has a dielectric constant higher than the dielectric constant of said liquid crystal layer.

[Claim 5] The liquid crystal display according to claim 1 to 4 characterized by being arranged almost in parallel [said projection is formed in the shape of a straight line, and] with said signal line.

[Claim 6] The liquid crystal display according to claim 1 to 4 characterized by being arranged almost in parallel [said projection is formed in the shape of a straight line, and] with said scanning line.

[Claim 7] The liquid crystal display according to claim 1 to 4 characterized by forming said projection in the shape of zigzag.

[Claim 8] The liquid crystal display according to claim 1 to 4 characterized by being arranged ranging over two pixel electrodes which adjoin in said direction of the scanning line while said projection is formed in the shape of zigzag along with said signal line.

[Claim 9] The liquid crystal display according to claim 1 to 4 characterized by being arranged ranging over two pixel electrodes which adjoin in said direction of a signal line while said projection is formed in the shape of zigzag along with said scanning line.

[Claim 10] The liquid crystal display according to claim 1 to 9 characterized by forming said projection on said orientation film.

[Claim 11] The part in which said projection exists is a liquid crystal display according to claim 1 to 10 characterized by removing the orientation film on said second substrate.

[Claim 12] The liquid crystal display according to claim 1 to 11 characterized by locating said slit in the center section of said pixel electrode at least.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid crystal display of the wide-field-of-view angle which prepared two or more domains in 1 pixel.

[0002]

[Description of the Prior Art] Generally the description of a thin light weight and a low power is shown in a liquid crystal display, and it is broadly used until it results [from a personal digital assistant] in large-sized television. The liquid crystal display of TN mold is often used as this liquid crystal display, and the engine performance high as a display and quality are maintained.

[0003] In the case of the TFT (ThinFilm Transistor) liquid crystal display of TN mold, it has arranged so that the substrate with which the pixel electrode was formed, and the substrate with which the common electrode was formed may be countered, and liquid crystal is enclosed between the substrates of this pair. Orientation processing is performed on the orientation film on both substrates by rubbing etc., and the direction of orientation is set up so that it may differ from the direction of orientation of the substrate which counters 90 degrees. A liquid crystal molecule is regulated in this direction of orientation, carries out horizontal arrangement in that direction, between substrates, horizontally, is twisted 90 degrees and arranged. Although a polarizing plate counters a substrate and is arranged on the outside of each substrate, at the time of normally black mode, it is arranged so that the transparency shaft of both polarizing plates may become in the same direction, and it is arranged at the time of a normally white mode so that the transparency shaft of both polarizing plates may make 90 degrees. Although the transmitted light which passed one polarizing plate turns into the linearly polarized light and a liquid crystal layer is passed, since the liquid crystal molecule was twisted 90 degrees at this time and it has arranged, the transmitted light **** and the polarization direction is twisted 90 degrees. At this time, in normally black mode, since the transmitted light which passed the liquid crystal layer cannot pass the polarizing plate of another side, it becomes a dark display, but since the transmitted light to which the liquid crystal layer was passed at the time of a normally white mode can pass the polarizing plate of another side, it serves as clear display.

[0004] However, the TN liquid crystal display etc. had problems, like a viewing-angle dependency is large. then, TN mold -- extensive -- the liquid crystal display of an angle of visibility IPS (In-Plane Switching) mold or VA (verticallyaligned) mold is proposed. The liquid crystal whose dielectric constant anisotropy is negative is enclosed between the substrates of a pair, a pixel electrode is arranged at one substrate and, as for the liquid crystal display of VA mold, the common electrode is arranged at the substrate of another side. Perpendicular orientation processing is performed to the orientation film on both substrates, and when not impressing an electrical potential difference to an electrode, the liquid crystal molecule is carrying out the perpendicular array. A polarizing plate is arranged on the outside of both substrates, and it is set up so that the transparency shaft of both polarizing plates may intersect perpendicularly. And since the liquid crystal molecule between substrates is carrying out the perpendicular array while not impressing the electrical potential difference to an electrode, the

transmitted light of the linearly polarized light which passed one polarizing plate passes a liquid crystal layer as it is, and is interrupted with the polarizing plate of another side. Moreover, since the liquid crystal molecule between substrates carries out horizontal arrangement when an electrical potential difference is impressed to an electrode, the birefringence of it is carried out, and the transmitted light of the linearly polarized light which passed one polarizing plate turns into passage light of elliptically polarized light, when passing a liquid crystal layer, and passes the polarizing plate of another side.

[0005] In order to improve further the angle of visibility of such a liquid crystal display, there is the approach of forming two or more domains in 1 pixel, and in order to form this domain, the projection and the slot are prepared in the pixel. This is indicated by for example, the patent No. 2947350 official report. For example, when preparing a projection in the substrate side of another side, the black matrix and the color filter were formed in the substrate of another side, and the color filter etc. is covered with the common electrode. The projection of a predetermined pattern is formed on this common electrode, and the laminating of the orientation film is carried out to the common electrode and the projection. This projection is formed with the dielectric which is the insulating material of a low dielectric.

[0006]

[Problem(s) to be Solved by the Invention] However, when preparing a projection in a pixel, a projection will exist between a pixel electrode and a common electrode, but since that projection is formed with the insulator of a low dielectric, the electrical potential difference impressed to a liquid crystal layer by this projection falls. Moreover, although impurity ion is floating in the liquid crystal layer, when the projection of a low dielectric exists on a common electrode, impurity ion focuses and adheres to the projection, and the seizure phenomenon of a display occurs. Thus, a projection will become a cause and a poor display will arise.

[0007] Then, this invention aims at offering the liquid crystal display of the wide-field-of-view angle in which two or more domains were formed in 1 pixel while it prevents display nonuniformity, such as printing.

[0008]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem invention according to claim 1 The first substrate in which the pixel electrode was formed in the pixel which arranges a signal line and the scanning line in the shape of a matrix, and is surrounded with a signal line and the scanning line, The second substrate in which the common electrode was formed, and the orientation film which performed perpendicular orientation processing by which a laminating is carried out on both substrates, In the liquid crystal display which a liquid crystal molecule inclines and is arranged when the dielectric constant anisotropy pinched among both substrates had the negative liquid crystal layer, a liquid crystal molecule carries out a perpendicular array when electric field are not impressed to the liquid crystal layer, and electric field are impressed to a liquid crystal layer It is characterized by having the projection of the conductor which is prepared in the second substrate and regulates the inclination direction of a liquid crystal molecule, the projection of a pixel electrode, and the slit formed in the part which counters.

[0009] Moreover, invention according to claim 2 is characterized by establishing a means to supply a common electrode and same electric potential to a projection.

[0010] Moreover, a projection extends continuously to the edge of the second substrate, and invention according to claim 3 is characterized by connecting with a common electrode electrically at the end.

[0011] Moreover, the first substrate in which the pixel electrode was formed in the pixel which invention according to claim 4 arranges a signal line and the scanning line in the shape of a matrix, and is surrounded with a signal line and the scanning line, The second substrate in which the common electrode was formed, and the orientation film which performed perpendicular orientation processing by which a laminating is carried out on both substrates, In the liquid crystal display which a liquid crystal molecule inclines and is arranged when the dielectric constant anisotropy pinched among both substrates had the negative liquid crystal layer, a liquid crystal molecule carries out a perpendicular array when electric field are not impressed to the liquid crystal layer, and electric field are impressed to a liquid crystal layer It has the projection which is prepared in the second substrate and regulates the inclination

direction of a liquid crystal molecule, the projection of a pixel electrode, and the slit formed in the part which counters, and is characterized by forming the projection with the dielectric which has a dielectric constant higher than the dielectric constant of a liquid crystal layer.

[0012] Moreover, a projection is formed in the shape of a straight line, and invention according to claim 5 is characterized by being arranged almost in parallel with a signal line.

[0013] Moreover, a projection is formed in the shape of a straight line, and invention according to claim 6 is characterized by being arranged almost in parallel with the scanning line.

[0014] Moreover, invention according to claim 7 is characterized by forming the projection in the shape of zigzag.

[0015] Moreover, invention according to claim 8 is characterized by being arranged ranging over two pixel electrodes which adjoin in the direction of the scanning line while a projection is formed in the shape of zigzag along with a signal line.

[0016] Moreover, invention according to claim 9 is characterized by being arranged ranging over two pixel electrodes which adjoin in the direction of a signal line while a projection is formed in the shape of zigzag along with the scanning line.

[0017] Moreover, invention according to claim 10 is characterized by forming the projection on the orientation film.

[0018] Moreover, invention according to claim 11 is characterized by removing the orientation film on the second substrate of the part in which a projection exists.

[0019] Moreover, invention according to claim 12 is characterized by locating a slit in the center section of the pixel electrode at least.

[0020]

[Embodiment of the Invention] Hereafter, the 1st example which is the gestalt of operation of this invention is explained based on drawing. The sectional view of a liquid crystal display when drawing 1 impresses the top view of the first substrate and drawing 2 is not impressing electric field, and drawing 3 are the sectional views of the liquid crystal display when impressing electric field. In addition, drawing 2 and drawing 3 are the sectional views which met the A-A line of drawing 1.

[0021] 1 is the first substrate of a glass substrate and the scanning line 2 and a signal line 3 are wired in the shape of a matrix on this first substrate 1. The field surrounded with the scanning line 2 and a signal line 3 is equivalent to 1 pixel, the pixel electrode 4 is arranged in this field, and the thin film transistor 5 linked to the pixel electrode 4 is formed in the intersection of the scanning line 2 and a signal line 3. As for the pixel electrode 4, a slit is formed in the center section, and this slit has become a signal line and parallel. 7 is the orientation film by which the laminating was carried out to the signal line 3 or the pixel electrode 4, and perpendicular orientation processing is performed.

[0022] 8 is the second substrate of a glass substrate, on the second substrate 8, the black matrix 9 is formed so that each pixel may be divided, and the laminating of the color filter 10 is carried out corresponding to each pixel. On the color filter 10, the laminating of the common electrodes 11, such as ITO, is carried out, and the laminating of the orientation film 12 with which perpendicular orientation processing was performed on the common electrode 11 is carried out.

[0023] The projection 13 of a conductor is formed in the location which counters the slit 6 and signal line 3 of the pixel electrode 4 on the orientation film 12. Drawing 4 is drawing having shown typically the physical relationship of projection 13 and the pixel electrode 4, and as shown in drawing 4, each projection 13 is arranged at juxtaposition. This projection 13 is formed with the same ingredient as the common electrodes 11, such as ITO, and serves as the common electrode 11 to same electric potential mostly. Here, in order to make projection 13 and the common electrode 11 into same electric potential, the projection 13 extended continuously to the edge of the second substrate 8, the field where the orientation film 12 does not exist in the edge of the second substrate 8 was prepared, and the common electrode 11 is connected with the projection 13 in the field. In addition, the configuration which does not limit to this gestalt if projection 13 serves as the common electrode 11 to same electric potential mostly, and connects the common electrode 11 with projection 13 electrically within the viewing area of the second substrate 8, and the configuration which supplies the same electrical potential difference as

the common electrode 11 to projection 13 directly may be used.

[0024] When forming a projection with the insulator of a low dielectric constant, a projection is made to counter the pixel electrode 4 and is arranged, but when forming projection 13 with a conductor, projection 13 is made to counter the part in which the pixel electrode 4 does not exist, and is arranged. This is because the direction where the liquid crystal molecule 14 breaks down from the projection of a low dielectric constant and the projection 13 of a conductor since distribution of the electric field of the projection 13 neighborhood differs becomes reverse. Drawing 5 is drawing showing actuation of the liquid crystal molecule 14 of the projection 13 neighborhood. Drawing 5 (a) shows the case where projection 13a is a conductor, and drawing 5 (b) shows the time of projection 13b being the insulator of a low dielectric constant here. Moreover, a dielectric constant anisotropy is negative, and when electric field do not occur, the perpendicular array of the liquid crystal molecule 14 is carried out. Although line of electric force A arises perpendicularly to the front face of projection 13 at the time of projection 13a of a conductor, line of electric force B arises almost in parallel to the slant face of projection 13b at the time of projection 13b of a low dielectric constant. And the liquid crystal molecule 14 inclines in the direction of the arrow head shown in drawing 5, and it will be in an parallel condition mostly with the slant face of projection 13a at the time of projection 13a of a conductor, and will be in a perpendicular condition mostly with the slant face of projection 13b at the time of projection 13b of a low dielectric constant. In addition, although the liquid crystal molecule 14 carries out the same actuation as the case where projection 13a is not covered by the orientation film 12 even when projection 13a of a conductor is covered by the perpendicular orientation film 12 The movement magnitude of the liquid crystal molecule 14 when impressing electric field, in order for the liquid crystal molecule 14 to be influenced by the orientation film 12 and to arrange almost perpendicularly to the slant face of projection 13a, when electric field are not impressed becomes large, and since the array condition of the liquid crystal molecule 14 changes, it will take time amount. Therefore, the direction which does not carry out the laminating of the orientation film 12 on projection 13a of a conductor changes to an array condition with the liquid crystal molecule 14 certainly optimal in a short time at the time of impression of electric field.

[0025] The projection 13 which countered the signal line 3 is greatly formed a little rather than the projection 13 made to counter a slit 6. Although this is because spacing of the pixel electrode 4 which adjoins on both sides of a signal line 3 is larger than the width of face of a slit 6, it is good as for same magnitude in each projection 13. That the magnitude of projection 13 just inclines in the direction in which the liquid crystal molecule 14 located in the projection 13 neighborhood with the line of electric force from the slant face of projection 13 when electric field are impressed was decided, as shown in drawing 6, when the width of face of projection 13 is 10 micrometers, there should just be 1 micrometers or more of height.

[0026] Although projection 13a is formed with the conductor in the 1st example, a projection may be formed with the dielectric which has a dielectric constant higher than the dielectric constant of liquid crystal. In the projection of a high dielectric constant, rather than projection 13b of a low dielectric constant, distribution of the electric field near a projection becomes close to the condition of projection 13a of a conductor, and falls on the slant face of a projection, and parallel like [actuation of the liquid crystal molecule 14 near a projection] the time of projection 13a of a conductor.

[0027] Between both the substrates 1 and 8, the liquid crystal whose dielectric constant anisotropy is negative is enclosed, and when not impressing an electrical potential difference to the pixel electrode 4, as the liquid crystal molecule 14 shows drawing 2, a perpendicular array is carried out in response to the effect of the perpendicular orientation film 7 and 12. At this time, although the projection 13 is not covered by the orientation film 12, the liquid crystal molecule 14 of the projection 13 neighborhood is influenced by the array condition of the adjoining liquid crystal molecule 14, and carries out the perpendicular array of it. Both the substrates 1 and 8 are put with the polarizing plate of the pair which is not illustrated, and when it has arranged so that the transparency shaft of the polarizing plate may intersect perpendicularly, the transmitted light which passed one polarizing plate passes a liquid crystal layer, without carrying out a birefringence with the liquid crystal molecule 14, and is intercepted with the polarizing plate of another side.

[0028] When an electrical potential difference is impressed to the pixel electrode 4, as shown in drawing 3, electric field occur between the pixel electrode 4 and the common electrode 11. The dotted line of drawing 3 shows line of electric force. Since projections 13 are the common electrode 11 and same electric potential at this time, electric field occur perpendicularly to the front face of projection 13, and the liquid crystal molecule 14 of the projection 13 neighborhood inclines so that electric-field line of force and that major axis may cross at right angles. Moreover, when it observes in the cross section shown in drawing 3, electric field occur toward the slanting upper part from the edge of the pixel electrode 4, and the liquid crystal molecule 14 near the edge of the pixel electrode 4 inclines so that the line of electric force from an edge and the major axis may cross at right angles. At this time, the liquid crystal molecule 14 of the projection 13 neighborhood and the liquid crystal molecule 14 near the edge of the pixel electrode 4 incline in the same direction, and the liquid crystal molecule 14 which adjoins in response to the effect of this inclined liquid crystal molecule 14 also inclines in the same direction. If it arranges so that it may not become the direction of a major axis of the liquid crystal molecule 14 and parallel which inclined the transparency shaft of the polarizing plate of a pair, with the liquid crystal molecule 14, the birefringence of the transmitted light which passed one polarizing plate will be carried out, and it will pass the polarizing plate of another side. Since an operation of the birefringence by the liquid crystal molecule 14 becomes the largest when the transparency shaft of a polarizing plate is leaned 45 degrees and has been arranged to the direction of a major axis of this inclined liquid crystal molecule 14, a white display can be performed efficiently. Since the liquid crystal molecule 14 inclines almost in parallel with the slant face of projection 13, the inclination direction of the liquid crystal molecule 14 becomes reverse bordering on projection 13. Therefore, in a pixel, two or more domains where the inclination directions of the liquid crystal molecule 14 differ exist, and the angle-of-visibility property is compensated mutually.

[0029] Thus, since the projection of a conductor was prepared, though it is the configuration of generating two or more domains in a pixel, a voltage drop can be prevented and it can prevent that impurity ion focuses and adheres.

[0030] Next, the 2nd example is explained based on drawing 7. Drawing 7 is the mimetic diagram showing the physical relationship of the pixel electrode 4 and projection 16, and is carrying out the same configuration as the 1st example except the slit 15 of the pixel electrode 4, and the configuration of projection 16. The parallel slit 15 is formed in the central part of this pixel electrode 4 with the scanning line 2, and projection 16 is formed in a slit 15 and the scanning line 2, and the location that counters. This projection 16 is also formed on the orientation film 12 with a conductor, and is electrically connected with the common electrode 11 in the part in which it extends continuously to the edge of the second substrate 8, and the orientation film 12 does not exist. And if electric field occur between the pixel electrode 4 and the common electrode 11, bordering on projection 16, the liquid crystal molecule 14 will incline to hard flow, and will form two or more domains in a pixel.

[0031] Next, the 3rd example is explained based on drawing 8. Drawing 8 is the mimetic diagram showing the physical relationship of the pixel electrode 4 and projection 18, and is carrying out the same configuration as the 1st example except the slit 17 of the pixel electrode 4, and the configuration of projection 18. The projection 18 of this conductor was formed in the shape of zigzag, and has extended continuously to the edge of the second substrate 8 along with a signal line 3. Moreover, the projection 18 has been arranged ranging over two pixel electrodes 4 which adjoin a scanning-line 2-way, and each projection 18 is located in a line in parallel. The slit 17 is formed in the location which corresponds to the pixel electrode 4 with projection 18. And if electric field occur between the pixel electrode 4 and the common electrode 11, bordering on projection 18, the liquid crystal molecule 14 will incline to hard flow, and will form two or more domains in a pixel. If 1 pixel is observed at this time, in 1 pixel, projection of two sides 18b mutually located in a line in parallel toward a different direction from projection of two sides 18a located in a line in parallel and its projection 18a exists. in order [that is,] for 2 sets of projections 18a and 18b which were suitable in the direction which is different in 1 pixel, respectively to exist, and for the liquid crystal molecule 14 to incline to hard flow among 1 set each of projections 18 and to form two domains -- the inside of 1 pixel -- four domains -- it can form --

extensive -- an angle of visibility liquid crystal display is realizable.

[0032] Although the projection 18 has been arranged along with a signal line 3 in this example, the configuration arranged along with the scanning line 2 may be used. In that case, a projection is arranged ranging over two pixel electrodes 4 which adjoin each other in the signal-line 3 direction, and each projection is put in order in parallel.

[0033] Next, the 4th example is explained based on drawing 9. Drawing 9 is the sectional view of a liquid crystal display, and corresponds to drawing 2 of the 1st example. Although, as for the 4th example, the methods of connection the 1st example, the common electrode 11, and projection 19 differ, other configurations are the same as the 1st example. The 4th example forms the projection 19 of a conductor on the common electrode 11 except for the orientation film 12 of a part with which projection 19 is located. Since projection 19 can connect with the common electrode 11 certainly at this time, projection 19 becomes the common electrode 11 and same electric potential. The method of formation this projection 19 carries out the laminating of the orientation film 12, after forming the common electrode 11 on the second substrate 8, and only the part in which projection 19 is located removes the orientation film 12, and it forms projection 19 for it after that. In this case, in consideration of the mask gap at the time of forming projection 19 grade, it is necessary to remove the orientation film 12 widely a little. As the method of other formation, projection 19 is previously formed on the common electrode 11, and after covering the common electrode 11 and projection 19 by the orientation film 12, only the part of projection 19 may remove the orientation film 12. Since projection 19 is certainly connected to the common electrode 11 regardless of the laminating condition of the orientation film 12 and the thing of a proper configuration can be formed at this time, the part which removes the orientation film 12 can be made into the minimum. For a touching [all projections 19]-common electrode 11 reason, although arranged corresponding to the slit 6 and signal line 3 of the pixel electrode 4, this projection 19 may not be made to extend continuously to the edge of the second substrate 8, or it may divide partially and it may be prepared. And when an electrical potential difference is impressed to the pixel electrode 4, the liquid crystal molecule 14 of the projection 19 neighborhood operates like the 1st example, and forms two or more domains in 1 pixel.

[0034] the domain of the plurality in each pixel since the projection was formed in the common electrode side by this invention as mentioned above, when electric field occur between a pixel electrode and a common electrode -- it can form -- extensive -- an angle of visibility liquid crystal display is made. the voltage drop produced when a projection becomes a common electrode and same electric potential, and it can prevent that impurity ion sticks to a projection intensively and the projection of a low dielectric constant exists in the part in a pixel, since the projection is furthermore formed with the conductor can be prevented, and uniform electric field are generated between a pixel electrode and a common electrode -- things can be carried out.

[0035] In addition, in the case of the projection of a conductor, the example explained, but a projection may be formed with the dielectric which has a dielectric constant higher than the dielectric constant of liquid crystal, and the same effectiveness as the projection of a conductor can be acquired also in this case. Moreover, in the projection of this invention, it is [that a projection counters near the edge of a pixel electrode and should just be arranged] also possible to take gestalten other than an example.

[0036]

[Effect of the Invention] Even when according to this invention a projection is prepared so that two or more domains may be formed in a pixel, it can reduce that impurity ion adheres to a projection intensively, and a phenomenon can be prevented for printing. Moreover, the voltage drop resulting from a projection can be decreased and a good display can be obtained.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the liquid crystal display of the wide-field-of-view angle which prepared two or more domains in 1 pixel.

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PRIOR ART

[Description of the Prior Art] Generally the description of a thin light weight and a low power is shown in a liquid crystal display, and it is broadly used until it results [from a personal digital assistant] in large-sized television. The liquid crystal display of TN mold is often used as this liquid crystal display, and the engine performance high as a display and quality are maintained.

[0003] In the case of the TFT (ThinFilm Transistor) liquid crystal display of TN mold, it has arranged so that the substrate with which the pixel electrode was formed, and the substrate with which the common electrode was formed may be countered, and liquid crystal is enclosed between the substrates of this pair. Orientation processing is performed on the orientation film on both substrates by rubbing etc., and the direction of orientation is set up so that it may differ from the direction of orientation of the substrate which counters 90 degrees. A liquid crystal molecule is regulated in this direction of orientation, carries out horizontal arrangement in that direction, between substrates, horizontally, is twisted 90 degrees and arranged. Although a polarizing plate counters a substrate and is arranged on the outside of each substrate, at the time of normally black mode, it is arranged so that the transparency shaft of both polarizing plates may become in the same direction, and it is arranged at the time of a normally white mode so that the transparency shaft of both polarizing plates may make 90 degrees. Although the transmitted light which passed one polarizing plate turns into the linearly polarized light and a liquid crystal layer is passed, since the liquid crystal molecule was twisted 90 degrees at this time and it has arranged, the transmitted light **** and the polarization direction is twisted 90 degrees. At this time, in normally black mode, since the transmitted light which passed the liquid crystal layer cannot pass the polarizing plate of another side, it becomes a dark display, but since the transmitted light to which the liquid crystal layer was passed at the time of a normally white mode can pass the polarizing plate of another side, it serves as clear display.

[0004] However, the TN liquid crystal display etc. had problems, like a viewing-angle dependency is large. then, TN mold -- extensive -- the liquid crystal display of an angle of visibility IPS (In-Plane Switching) mold or VA (verticallyaligned) mold is proposed. The liquid crystal whose dielectric constant anisotropy is negative is enclosed between the substrates of a pair, a pixel electrode is arranged at one substrate and, as for the liquid crystal display of VA mold, the common electrode is arranged at the substrate of another side. Perpendicular orientation processing is performed to the orientation film on both substrates, and when not impressing an electrical potential difference to an electrode, the liquid crystal molecule is carrying out the perpendicular array. A polarizing plate is arranged on the outside of both substrates, and it is set up so that the transparency shaft of both polarizing plates may intersect perpendicularly. And since the liquid crystal molecule between substrates is carrying out the perpendicular array while not impressing the electrical potential difference to an electrode, the transmitted light of the linearly polarized light which passed one polarizing plate passes a liquid crystal layer as it is, and is interrupted with the polarizing plate of another side. Moreover, since the liquid crystal molecule between substrates carries out horizontal arrangement when an electrical potential difference is impressed to an electrode, the birefringence of it is carried out, and the transmitted light of the linearly polarized light which passed one polarizing plate turns into passage light of elliptically

polarized light, when passing a liquid crystal layer, and passes the polarizing plate of another side.

[0005] In order to improve further the angle of visibility of such a liquid crystal display, there is the approach of forming two or more domains in 1 pixel, and in order to form this domain, the projection and the slot are prepared in the pixel. This is indicated by for example, the patent No. 2947350 official report. For example, when preparing a projection in the substrate side of another side, the black matrix and the color filter were formed in the substrate of another side, and the color filter etc. is covered with the common electrode. The projection of a predetermined pattern is formed on this common electrode, and the laminating of the orientation film is carried out to the common electrode and the projection. This projection is formed with the dielectric which is the insulating material of a low dielectric.

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EFFECT OF THE INVENTION

[Effect of the Invention] Even when according to this invention a projection is prepared so that two or more domains may be formed in a pixel, it can reduce that impurity ion adheres to a projection intensively, and a phenomenon can be prevented for printing. Moreover, the voltage drop resulting from a projection can be decreased and a good display can be obtained.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, when preparing a projection in a pixel, a projection will exist between a pixel electrode and a common electrode, but since that projection is formed with the insulator of a low dielectric, the electrical potential difference impressed to a liquid crystal layer by this projection falls. Moreover, although impurity ion is floating in the liquid crystal layer, when the projection of a low dielectric exists on a common electrode, impurity ion focuses and adheres to the projection, and the seizure phenomenon of a display occurs. Thus, a projection will become a cause and a poor display will arise.

[0007] Then, this invention aims at offering the liquid crystal display of the wide-field-of-view angle in which two or more domains were formed in 1 pixel while it prevents display nonuniformity, such as printing.

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MEANS

[Means for Solving the Problem] In order to solve the above-mentioned technical problem invention according to claim 1 The first substrate in which the pixel electrode was formed in the pixel which arranges a signal line and the scanning line in the shape of a matrix, and is surrounded with a signal line and the scanning line, The second substrate in which the common electrode was formed, and the orientation film which performed perpendicular orientation processing by which a laminating is carried out on both substrates, In the liquid crystal display which a liquid crystal molecule inclines and is arranged when the dielectric constant anisotropy pinched among both substrates had the negative liquid crystal layer, a liquid crystal molecule carries out a perpendicular array when electric field are not impressed to the liquid crystal layer, and electric field are impressed to a liquid crystal layer It is characterized by having the projection of the conductor which is prepared in the second substrate and regulates the inclination direction of a liquid crystal molecule, the projection of a pixel electrode, and the slit formed in the part which counters.

[0009] Moreover, invention according to claim 2 is characterized by establishing a means to supply a common electrode and same electric potential to a projection.

[0010] Moreover, a projection extends continuously to the edge of the second substrate, and invention according to claim 3 is characterized by connecting with a common electrode electrically at the end.

[0011] Moreover, the first substrate in which the pixel electrode was formed in the pixel which invention according to claim 4 arranges a signal line and the scanning line in the shape of a matrix, and is surrounded with a signal line and the scanning line, The second substrate in which the common electrode was formed, and the orientation film which performed perpendicular orientation processing by which a laminating is carried out on both substrates, In the liquid crystal display which a liquid crystal molecule inclines and is arranged when the dielectric constant anisotropy pinched among both substrates had the negative liquid crystal layer, a liquid crystal molecule carries out a perpendicular array when electric field are not impressed to the liquid crystal layer, and electric field are impressed to a liquid crystal layer It has the projection which is prepared in the second substrate and regulates the inclination direction of a liquid crystal molecule, the projection of a pixel electrode, and the slit formed in the part which counters, and is characterized by forming the projection with the dielectric which has a dielectric constant higher than the dielectric constant of a liquid crystal layer.

[0012] Moreover, a projection is formed in the shape of a straight line, and invention according to claim 5 is characterized by being arranged almost in parallel with a signal line.

[0013] Moreover, a projection is formed in the shape of a straight line, and invention according to claim 6 is characterized by being arranged almost in parallel with the scanning line.

[0014] Moreover, invention according to claim 7 is characterized by forming the projection in the shape of zigzag.

[0015] Moreover, invention according to claim 8 is characterized by being arranged ranging over two pixel electrodes which adjoin in the direction of the scanning line while a projection is formed in the shape of zigzag along with a signal line.

[0016] Moreover, invention according to claim 9 is characterized by being arranged ranging over two

pixel electrodes which adjoin in the direction of a signal line while a projection is formed in the shape of zigzag along with the scanning line.

[0017] Moreover, invention according to claim 10 is characterized by forming the projection on the orientation film.

[0018] Moreover, invention according to claim 11 is characterized by removing the orientation film on the second substrate of the part in which a projection exists.

[0019] Moreover, invention according to claim 12 is characterized by locating a slit in the center section of the pixel electrode at least.

[0020]

[Embodiment of the Invention] Hereafter, the 1st example which is the gestalt of operation of this invention is explained based on drawing. The sectional view of a liquid crystal display when drawing 1 impresses the top view of the first substrate and drawing 2 is not impressing electric field, and drawing 3 are the sectional views of the liquid crystal display when impressing electric field. In addition, drawing 2 and drawing 3 are the sectional views which met the A-A line of drawing 1.

[0021] 1 is the first substrate of a glass substrate and the scanning line 2 and a signal line 3 are wired in the shape of a matrix on this first substrate 1. The field surrounded with the scanning line 2 and a signal line 3 is equivalent to 1 pixel, the pixel electrode 4 is arranged in this field, and the thin film transistor 5 linked to the pixel electrode 4 is formed in the intersection of the scanning line 2 and a signal line 3. As for the pixel electrode 4, a slit is formed in the center section, and this slit has become a signal line and parallel. 7 is the orientation film by which the laminating was carried out to the signal line 3 or the pixel electrode 4, and perpendicular orientation processing is performed.

[0022] 8 is the second substrate of a glass substrate, on the second substrate 8, the black matrix 9 is formed so that each pixel may be divided, and the laminating of the color filter 10 is carried out corresponding to each pixel. On the color filter 10, the laminating of the common electrodes 11, such as ITO, is carried out, and the laminating of the orientation film 12 with which perpendicular orientation processing was performed on the common electrode 11 is carried out.

[0023] The projection 13 of a conductor is formed in the location which counters the slit 6 and signal line 3 of the pixel electrode 4 on the orientation film 12. Drawing 4 is drawing having shown typically the physical relationship of projection 13 and the pixel electrode 4, and as shown in drawing 4, each projection 13 is arranged at juxtaposition. This projection 13 is formed with the same ingredient as the common electrodes 11, such as ITO, and serves as the common electrode 11 to same electric potential mostly. Here, in order to make projection 13 and the common electrode 11 into same electric potential, the projection 13 extended continuously to the edge of the second substrate 8, the field where the orientation film 12 does not exist in the edge of the second substrate 8 was prepared, and the common electrode 11 is connected with the projection 13 in the field. In addition, the configuration which does not limit to this gestalt if projection 13 serves as the common electrode 11 to same electric potential mostly, and connects the common electrode 11 with projection 13 electrically within the viewing area of the second substrate 8, and the configuration which supplies the same electrical potential difference as the common electrode 11 to projection 13 directly may be used.

[0024] When forming a projection with the insulator of a low dielectric constant, a projection is made to counter the pixel electrode 4 and is arranged, but when forming projection 13 with a conductor, projection 13 is made to counter the part in which the pixel electrode 4 does not exist, and is arranged. This is because the direction where the liquid crystal molecule 14 breaks down from the projection of a low dielectric constant and the projection 13 of a conductor since distribution of the electric field of the projection 13 neighborhood differs becomes reverse. Drawing 5 is drawing showing actuation of the liquid crystal molecule 14 of the projection 13 neighborhood. Drawing 5 (a) shows the case where projection 13a is a conductor, and drawing 5 (b) shows the time of projection 13b being the insulator of a low dielectric constant here. Moreover, a dielectric constant anisotropy is negative, and when electric field do not occur, the perpendicular array of the liquid crystal molecule 14 is carried out. Although line of electric force A arises perpendicularly to the front face of projection 13 at the time of projection 13a of a conductor, line of electric force B arises almost in parallel to the slant face of projection 13b at the

time of projection 13b of a low dielectric constant. And the liquid crystal molecule 14 inclines in the direction of the arrow head shown in drawing 5, and it will be in an parallel condition mostly with the slant face of projection 13a at the time of projection 13a of a conductor, and will be in a perpendicular condition mostly with the slant face of projection 13b at the time of projection 13b of a low dielectric constant. In addition, although the liquid crystal molecule 14 carries out the same actuation as the case where projection 13a is not covered by the orientation film 12 even when projection 13a of a conductor is covered by the perpendicular orientation film 12 The movement magnitude of the liquid crystal molecule 14 when impressing electric field, in order for the liquid crystal molecule 14 to be influenced by the orientation film 12 and to arrange almost perpendicularly to the slant face of projection 13a, when electric field are not impressed becomes large, and since the array condition of the liquid crystal molecule 14 changes, it will take time amount. Therefore, the direction which does not carry out the laminating of the orientation film 12 on projection 13a of a conductor changes to an array condition with the liquid crystal molecule 14 certainly optimal in a short time at the time of impression of electric field. [0025] The projection 13 which countered the signal line 3 is greatly formed a little rather than the projection 13 made to counter a slit 6. Although this is because spacing of the pixel electrode 4 which adjoins on both sides of a signal line 3 is larger than the width of face of a slit 6, it is good as for same magnitude in each projection 13. That the magnitude of projection 13 just inclines in the direction in which the liquid crystal molecule 14 located in the projection 13 neighborhood with the line of electric force from the slant face of projection 13 when electric field are impressed was decided, as shown in drawing 6, when the width of face of projection 13 is 10 micrometers, there should just be 1 micrometers or more of height.

[0026] Although projection 13a is formed with the conductor in the 1st example, a projection may be formed with the dielectric which has a dielectric constant higher than the dielectric constant of liquid crystal. In the projection of a high dielectric constant, rather than projection 13b of a low dielectric constant, distribution of the electric field near a projection becomes close to the condition of projection 13a of a conductor, and falls on the slant face of a projection, and parallel like [actuation of the liquid crystal molecule 14 near a projection] the time of projection 13a of a conductor.

[0027] Between both the substrates 1 and 8, the liquid crystal whose dielectric constant anisotropy is negative is enclosed, and when not impressing an electrical potential difference to the pixel electrode 4, as the liquid crystal molecule 14 shows drawing 2, a perpendicular array is carried out in response to the effect of the perpendicular orientation film 7 and 12. At this time, although the projection 13 is not covered by the orientation film 12, the liquid crystal molecule 14 of the projection 13 neighborhood is influenced by the array condition of the adjoining liquid crystal molecule 14, and carries out the perpendicular array of it. Both the substrates 1 and 8 are put with the polarizing plate of the pair which is not illustrated, and when it has arranged so that the transparency shaft of the polarizing plate may intersect perpendicularly, the transmitted light which passed one polarizing plate passes a liquid crystal layer, without carrying out a birefringence with the liquid crystal molecule 14, and is intercepted with the polarizing plate of another side.

[0028] When an electrical potential difference is impressed to the pixel electrode 4, as shown in drawing 3, electric field occur between the pixel electrode 4 and the common electrode 11. The dotted line of drawing 3 shows line of electric force. Since projections 13 are the common electrode 11 and same electric potential at this time, electric field occur perpendicularly to the front face of projection 13, and the liquid crystal molecule 14 of the projection 13 neighborhood inclines so that electric-field line of force and that major axis may cross at right angles. Moreover, when it observes in the cross section shown in drawing 3, electric field occur toward the slanting upper part from the edge of the pixel electrode 4, and the liquid crystal molecule 14 near the edge of the pixel electrode 4 inclines so that the line of electric force from an edge and the major axis may cross at right angles. At this time, the liquid crystal molecule 14 of the projection 13 neighborhood and the liquid crystal molecule 14 near the edge of the pixel electrode 4 incline in the same direction, and the liquid crystal molecule 14 which adjoins in response to the effect of this inclined liquid crystal molecule 14 also inclines in the same direction. If it arranges so that it may not become the direction of a major axis of the liquid crystal molecule 14 and

parallel which inclined the transparency shaft of the polarizing plate of a pair, with the liquid crystal molecule 14, the birefringence of the transmitted light which passed one polarizing plate will be carried out, and it will pass the polarizing plate of another side. Since an operation of the birefringence by the liquid crystal molecule 14 becomes the largest when the transparency shaft of a polarizing plate is leaned 45 degrees and has been arranged to the direction of a major axis of this inclined liquid crystal molecule 14, a white display can be performed efficiently. Since the liquid crystal molecule 14 inclines almost in parallel with the slant face of projection 13, the inclination direction of the liquid crystal molecule 14 becomes reverse bordering on projection 13. Therefore, in a pixel, two or more domains where the inclination directions of the liquid crystal molecule 14 differ exist, and the angle-of-visibility property is compensated mutually.

[0029] Thus, since the projection of a conductor was prepared, though it is the configuration of generating two or more domains in a pixel, a voltage drop can be prevented and it can prevent that impurity ion focuses and adheres.

[0030] Next, the 2nd example is explained based on drawing 7. Drawing 7 is the mimetic diagram showing the physical relationship of the pixel electrode 4 and projection 16, and is carrying out the same configuration as the 1st example except the slit 15 of the pixel electrode 4, and the configuration of projection 16. The parallel slit 15 is formed in the central part of this pixel electrode 4 with the scanning line 2, and projection 16 is formed in a slit 15 and the scanning line 2, and the location that counters. This projection 16 is also formed on the orientation film 12 with a conductor, and is electrically connected with the common electrode 11 in the part in which it extends continuously to the edge of the second substrate 8, and the orientation film 12 does not exist. And if electric field occur between the pixel electrode 4 and the common electrode 11, bordering on projection 16, the liquid crystal molecule 14 will incline to hard flow, and will form two or more domains in a pixel.

[0031] Next, the 3rd example is explained based on drawing 8. Drawing 8 is the mimetic diagram showing the physical relationship of the pixel electrode 4 and projection 18, and is carrying out the same configuration as the 1st example except the slit 17 of the pixel electrode 4, and the configuration of projection 18. The projection 18 of this conductor was formed in the shape of zigzag, and has extended continuously to the edge of the second substrate 8 along with a signal line 3. Moreover, the projection 18 has been arranged ranging over two pixel electrodes 4 which adjoin a scanning-line 2-way, and each projection 18 is located in a line in parallel. The slit 17 is formed in the location which corresponds to the pixel electrode 4 with projection 18. And if electric field occur between the pixel electrode 4 and the common electrode 11, bordering on projection 18, the liquid crystal molecule 14 will incline to hard flow, and will form two or more domains in a pixel. If 1 pixel is observed at this time, in 1 pixel, projection of two sides 18b mutually located in a line in parallel toward a different direction from projection of two sides 18a located in a line in parallel and its projection 18a exists. in order [that is,] for 2 sets of projections 18a and 18b which were suitable in the direction which is different in 1 pixel, respectively to exist, and for the liquid crystal molecule 14 to incline to hard flow among 1 set each of projections 18 and to form two domains -- the inside of 1 pixel -- four domains -- it can form -- extensive -- an angle of visibility liquid crystal display is realizable.

[0032] Although the projection 18 has been arranged along with a signal line 3 in this example, the configuration arranged along with the scanning line 2 may be used. In that case, a projection is arranged ranging over two pixel electrodes 4 which adjoin each other in the signal-line 3 direction, and each projection is put in order in parallel.

[0033] Next, the 4th example is explained based on drawing 9. Drawing 9 is the sectional view of a liquid crystal display, and corresponds to drawing 2 of the 1st example. Although, as for the 4th example, the methods of connection the 1st example, the common electrode 11, and projection 19 differ, other configurations are the same as the 1st example. The 4th example forms the projection 19 of a conductor on the common electrode 11 except for the orientation film 12 of a part with which projection 19 is located. Since projection 19 can connect with the common electrode 11 certainly at this time, projection 19 becomes the common electrode 11 and same electric potential. The method of formation this projection 19 carries out the laminating of the orientation film 12, after forming the common

electrode 11 on the second substrate 8, and only the part in which projection 19 is located removes the orientation film 12, and it forms projection 19 for it after that. In this case, in consideration of the mask gap at the time of forming projection 19 grade, it is necessary to remove the orientation film 12 widely a little. As the method of other formation, projection 19 is previously formed on the common electrode 11, and after covering the common electrode 11 and projection 19 by the orientation film 12, only the part of projection 19 may remove the orientation film 12. Since projection 19 is certainly connected to the common electrode 11 regardless of the laminating condition of the orientation film 12 and the thing of a proper configuration can be formed at this time, the part which removes the orientation film 12 can be made into the minimum. For a touching [all projections 19]-common electrode 11 reason, although arranged corresponding to the slit 6 and signal line 3 of the pixel electrode 4, this projection 19 may not be made to extend continuously to the edge of the second substrate 8, or it may divide partially and it may be prepared. And when an electrical potential difference is impressed to the pixel electrode 4, the liquid crystal molecule 14 of the projection 19 neighborhood operates like the 1st example, and forms two or more domains in 1 pixel.

[0034] the domain of the plurality in each pixel since the projection was formed in the common electrode side by this invention as mentioned above, when electric field occur between a pixel electrode and a common electrode -- it can form -- extensive -- an angle of visibility liquid crystal display is made. the voltage drop produced when a projection becomes a common electrode and same electric potential, and it can prevent that impurity ion sticks to a projection intensively and the projection of a low dielectric constant exists in the part in a pixel, since the projection is furthermore formed with the conductor can be prevented, and uniform electric field are generated between a pixel electrode and a common electrode -- things can be carried out.

[0035] In addition, in the case of the projection of a conductor, the example explained, but a projection may be formed with the dielectric which has a dielectric constant higher than the dielectric constant of liquid crystal, and the same effectiveness as the projection of a conductor can be acquired also in this case. Moreover, in the projection of this invention, it is [that a projection counters near the edge of a pixel electrode and should just be arranged] also possible to take gestalten other than an example.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the top view of the first substrate of the liquid crystal display which is the 1st example of this invention.

[Drawing 2] It is the sectional view of a liquid crystal display when not impressing electric field.

[Drawing 3] It is the sectional view of the liquid crystal display when impressing electric field.

[Drawing 4] It is the mimetic diagram having shown the physical relationship of the pixel electrode of liquid crystal equipment and projection which are the 1st example.

[Drawing 5] It is drawing explaining actuation of the liquid crystal molecule located near the projection at the time of impressing an electrical potential difference.

[Drawing 6] It is the expanded sectional view of a projection of the 1st example.

[Drawing 7] It is the mimetic diagram having shown the physical relationship of the pixel electrode of a liquid crystal display and projection which are the 2nd example.

[Drawing 8] It is the mimetic diagram having shown the physical relationship of the pixel electrode of a liquid crystal display and projection which are the 3rd example.

[Drawing 9] It is a sectional view when not impressing the electric field of the liquid crystal display which is the 4th example.

[Description of Notations]

1 First Substrate

2 Scanning Line

3 Signal Line

4 Pixel Electrode

6, 15, 17 Slit

7 12 Orientation film

8 Second Substrate

11 Common Electrode

13, 16, 18, 19 Projection

14 Liquid Crystal Molecule

[Translation done.]

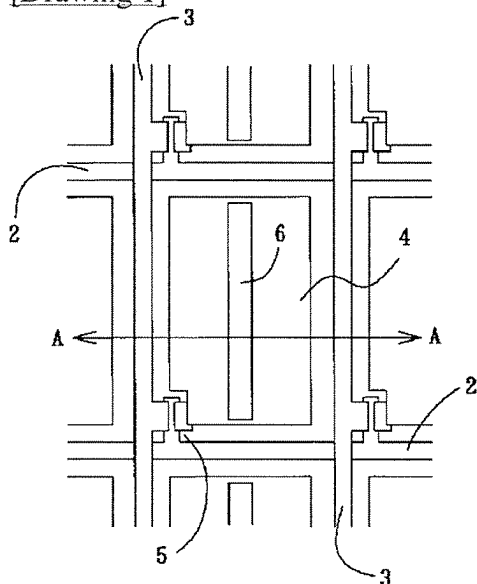
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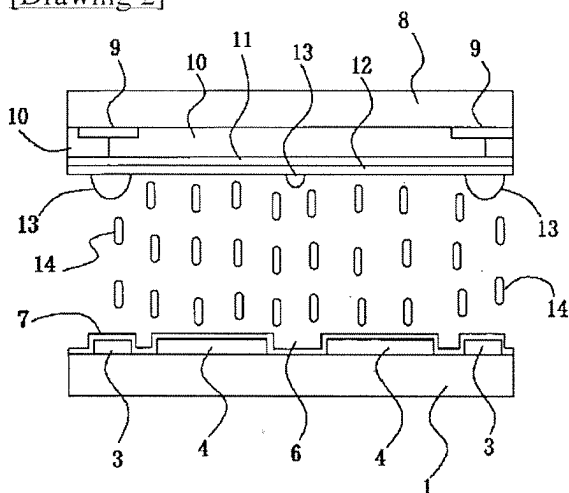
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DRAWINGS

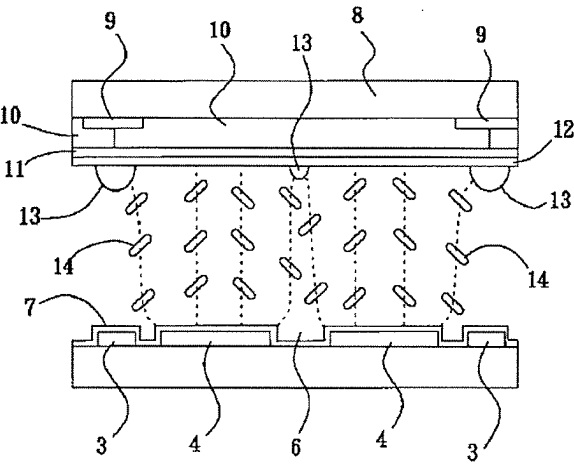
[Drawing 1]



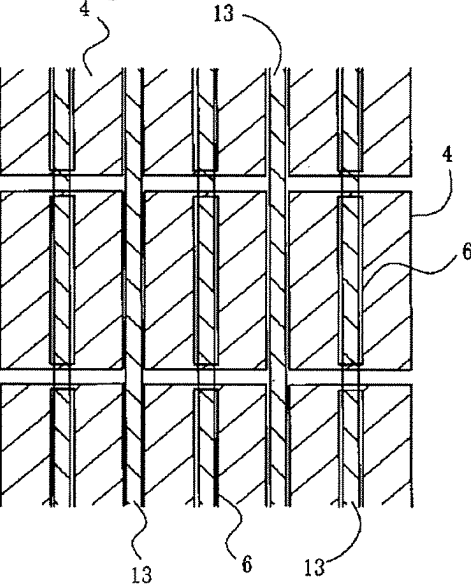
[Drawing 2]



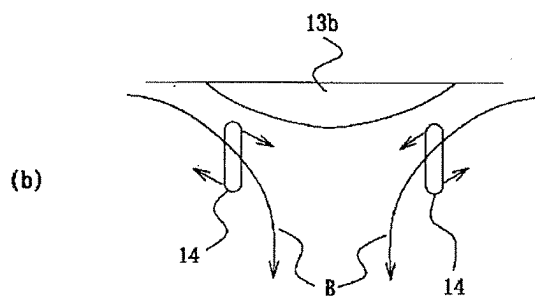
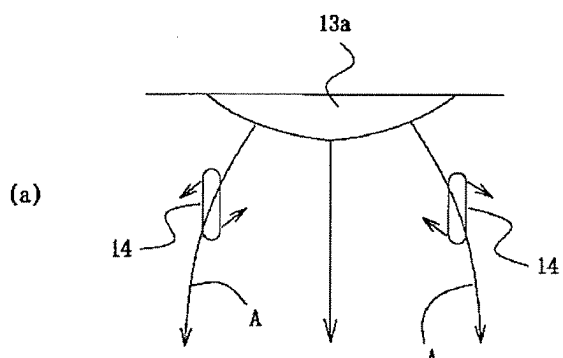
[Drawing 3]



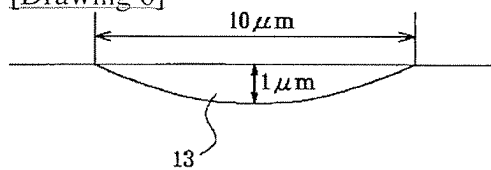
[Drawing 4]



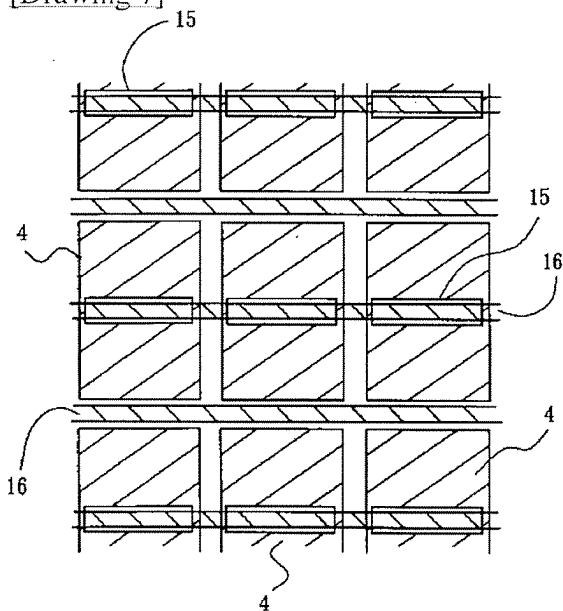
[Drawing 5]



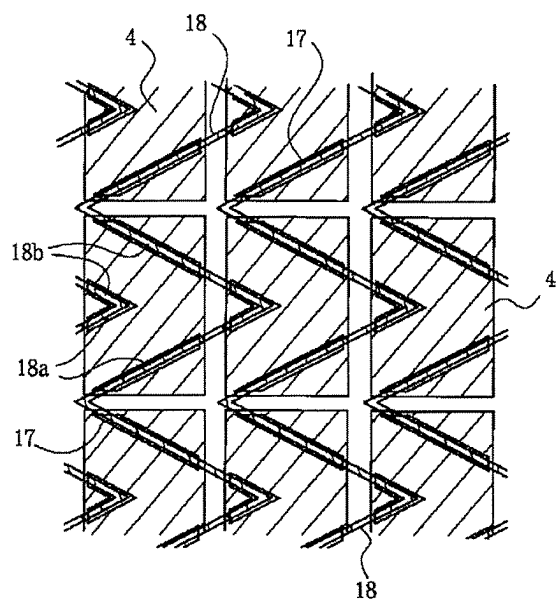
[Drawing 6]



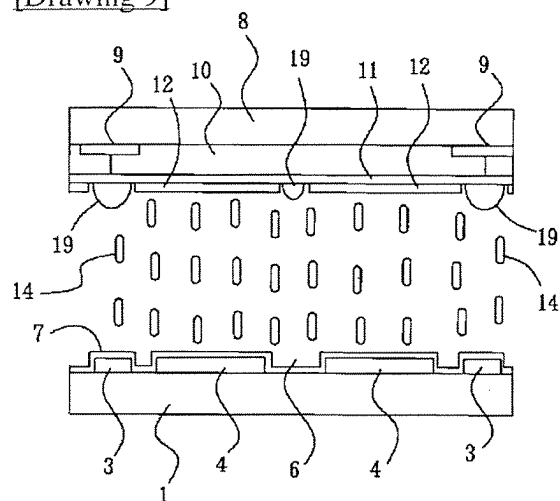
[Drawing 7]



[Drawing 8]



[Drawing 9]



[Translation done.]

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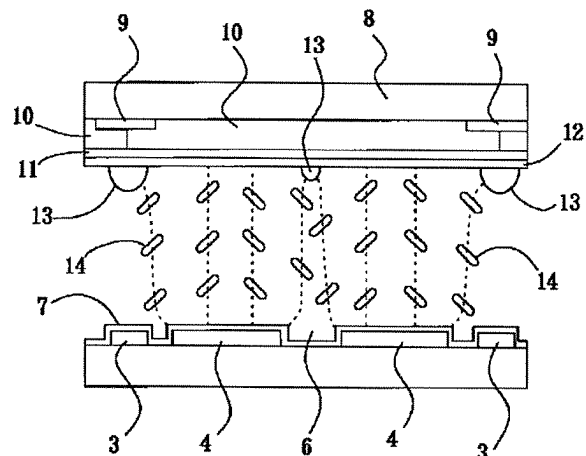
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(54)【発明の名称】 液晶表示装置

(57)【要約】

【目的】 焼付き現象等の表示ムラを防止すると共に、1画素内に複数のドメインを形成した広視野角の液晶表示装置を提供することを目的とする。

【構成】 画素電極4を有する第一基板1と共通電極11を有する第二基板8を対向配置し、両基板1、8間に誘電率異方性が負の液晶14を挟持する。両基板1、8を垂直配向膜7、12で覆い、液晶層に電界が印加されていないときは液晶分子14が垂直配列し、液晶層に電界が印加されたときは液晶分子14が傾斜して配列する液晶表示装置において、第二基板8に電界印加時の液晶分子14の傾斜方向を規制する導電体の突起13を設け、画素電極4には突起13と対向する部分にスリット6を形成する。



【特許請求の範囲】

【請求項 1】 信号線と走査線をマトリクス状に配置し、前記信号線と前記走査線で囲まれる画素内に画素電極を形成した第一基板と、共通電極を形成した第二基板と、前記両基板上に積層される垂直配向処理を施した配向膜と、前記両基板間に挟持される誘電率異方性が負の液晶層とを有し、前記液晶層に電界が印加されていないときは液晶分子が垂直配列し、前記液晶層に電界が印加されたときは液晶分子が傾斜して配列する液晶表示装置において、前記第二基板に設けられ且つ前記液晶分子の傾斜方向を規制する導電体の突起と、前記画素電極の前記突起と対向する部分に形成されたスリットとを有することを特徴とする液晶表示装置。

【請求項 2】 前記突起に前記共通電極と同電位を供給する手段を設けたことを特徴とする請求項 1 記載の液晶表示装置。

【請求項 3】 前記突起は前記第二基板の端部まで連続的に延在し、前記端部で前記共通電極と電気的に接続することを特徴とする請求項 2 記載の液晶表示装置。

【請求項 4】 信号線と走査線をマトリクス状に配置し、前記信号線と前記走査線で囲まれる画素内に画素電極を形成した第一基板と、共通電極を形成した第二基板と、前記両基板上に積層される垂直配向処理を施した配向膜と、前記両基板間に挟持される誘電率異方性が負の液晶層とを有し、前記液晶層に電界が印加されていないときは液晶分子が垂直配列し、前記液晶層に電界が印加されたときは液晶分子が傾斜して配列する液晶表示装置において、前記第二基板に設けられ且つ前記液晶分子の傾斜方向を規制する突起と、前記画素電極の前記突起と対向する部分に形成されたスリットとを有し、前記突起は前記液晶層の誘電率よりも高い誘電率を有する誘電体によって形成されていることを特徴とする液晶表示装置。

【請求項 5】 前記突起が直線状に形成され、且つ前記信号線とはほぼ平行に配置されていることを特徴とする請求項 1 乃至請求項 4 記載の液晶表示装置。

【請求項 6】 前記突起が直線状に形成され、且つ前記走査線とはほぼ平行に配置されていることを特徴とする請求項 1 乃至請求項 4 記載の液晶表示装置。

【請求項 7】 前記突起がジグザグ状に形成されていることを特徴とする請求項 1 乃至請求項 4 記載の液晶表示装置。

【請求項 8】 前記突起が前記信号線に沿ってジグザグ状に形成されると共に前記走査線方向に隣接する 2 つの画素電極にまたがって配置されていることを特徴とする請求項 1 乃至請求項 4 記載の液晶表示装置。

【請求項 9】 前記突起が前記走査線に沿ってジグザグ状に形成されると共に前記信号線方向に隣接する 2 つの画素電極にまたがって配置されていることを特徴とする請求項 1 乃至請求項 4 記載の液晶表示装置。

【請求項 10】 前記突起が前記配向膜上に形成されていることを特徴とする請求項 1 乃至請求項 9 記載の液晶表示装置。

【請求項 11】 前記突起が存在する部分は前記第二基板上の配向膜が除去されていることを特徴とする請求項 1 乃至請求項 10 記載の液晶表示装置。

【請求項 12】 前記スリットが少なくとも前記画素電極の中央部に位置することを特徴とする請求項 1 乃至請求項 11 記載の液晶表示装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は 1 画素内に複数のドメインを設けた広視野角の液晶表示装置に関する。

【0002】

【従来の技術】一般に液晶表示装置には薄型軽量、低消費電力という特徴があり、携帯端末から大型テレビに至るまで幅広く利用されている。この液晶表示装置として TN 型の液晶表示装置がよく使われ、表示装置として高い性能、品質を維持している。

【0003】TN 型の TFT (Thin Film Transistor) 液晶表示装置の場合、画素電極が形成された基板と共通電極が形成された基板を対向するように配置し、この一対の基板間に液晶を封入している。両基板上の配向膜にはラビング等によって配向処理が行われ、その配向方向は対向する基板の配向方向と 90 度異なるように設定されている。液晶分子はこの配向方向に規制されてその方向に水平配列し、基板間では水平方向に 90 度捻れて配列する。各基板の外側には偏光板が基板に対向して配置されるが、ノーマリブラックモードのときは両偏光板の透過軸が同一方向になるように配置され、ノーマリホワイトモードのときには両偏光板の透過軸が 90 度をなすように配置される。一方の偏光板を通過した透過光は直線偏光となって液晶層を通過するが、このとき液晶分子が 90 度捻れて配列しているので透過光は旋廻して偏光方向が 90 度捻れる。このときノーマリブラックモードでは液晶層を通過した透過光は他方の偏光板を通過できないので暗表示になるが、ノーマリホワイトモードのときは液晶層を通過した透過光は他方の偏光板を通過できるので明表示となる。

【0004】しかし TN 型液晶表示装置等は視角依存性が高い等の問題があった。そこで TN 型よりも広視野角な IPS (In-Plane Switching) 型や VA (vertically aligned) 型の液晶表示装置が提案されている。VA 型の液晶表示装置は、一対の基板間に誘電率異方性が負の液晶が封入され、一方の基板には画素電極が、他方の基板には共通電極が配置されている。両基板上の配向膜には垂直配向処理が施され、電極に電圧を印加しないときは液晶分子が垂直配列している。両基板の外側には偏光板が配置され、両偏光板の透過軸が直交するように設定されている。そして電極に電圧を印加していないとき

は基板間の液晶分子が垂直配列しているので、一方の偏光板を通過した直線偏光の透過光がそのまま液晶層を通過して他方の偏光板によって遮られる。また電極に電圧を印加したときは基板間の液晶分子が水平配列するので、一方の偏光板を通過した直線偏光の透過光は液晶層を通過するときに複屈折され楕円偏光の通過光になり、他方の偏光板を通過する。

【0005】こうした液晶表示装置の視野角を更に改善するために、1画素内に複数のドメインを形成する方法があり、このドメインを形成するために画素内に突起や溝を設けている。これは例えば特許第2947350号公報に記載されている。例えば、他方の基板側に突起を設ける場合、他方の基板にブラックマトリックスとカラーフィルタを形成し、カラーフィルタ等を共通電極で覆っている。この共通電極上に所定パターンの突起を形成し、共通電極及び突起に配向膜を積層している。この突起は低誘電性の絶縁物である誘電体で形成されている。

【0006】

【発明が解決しようとする課題】しかし画素内に突起を設ける場合、画素電極と共通電極の間に突起が存在することになるが、その突起が低誘電性の絶縁体で形成されているため、この突起によって液晶層に印加される電圧が低下する。また、液晶層には不純物イオンが浮遊しているが、共通電極上に低誘電性の突起が存在する場合は不純物イオンがその突起に集中して付着してしまい、表示の焼付き現象が発生する。このように突起が原因となって表示不良が生じてしまう。

【0007】そこで本発明は、焼付き等の表示ムラを防止すると共に、1画素内に複数のドメインを形成した広視野角の液晶表示装置を提供することを目的とする。

【0008】

【課題を解決するための手段】上記課題を解決するために請求項1記載の発明は、信号線と走査線をマトリクス状に配置し、信号線と走査線で囲まれる画素内に画素電極を形成した第一基板と、共通電極を形成した第二基板と、両基板上に積層される垂直配向処理を施した配向膜と、両基板間に挟持される誘電率異方性が負の液晶層とを有し、液晶層に電界が印加されていないときは液晶分子が垂直配列し、液晶層に電界が印加されたときは液晶分子が傾斜して配列する液晶表示装置において、第二基板に設けられ且つ液晶分子の傾斜方向を規制する導電体の突起と、画素電極の突起と対向する部分に形成されたスリットとを有することを特徴とする。

【0009】また請求項2記載の発明は、突起に共通電極と同電位を供給する手段を設けたことを特徴とする。

【0010】また請求項3記載の発明は、突起が第二基板の端部まで連続的に延在し、端部で共通電極と電気的に接続することを特徴とする。

【0011】また請求項4記載の発明は、信号線と走査線をマトリクス状に配置し、信号線と走査線で囲まれる

画素内に画素電極を形成した第一基板と、共通電極を形成した第二基板と、両基板上に積層される垂直配向処理を施した配向膜と、両基板間に挟持される誘電率異方性が負の液晶層とを有し、液晶層に電界が印加されていないときは液晶分子が垂直配列し、液晶層に電界が印加されたときは液晶分子が傾斜して配列する液晶表示装置において、第二基板に設けられ且つ液晶分子の傾斜方向を規制する突起と、画素電極の突起と対向する部分に形成されたスリットとを有し、突起は液晶層の誘電率よりも高い誘電率を有する誘電体によって形成されていることを特徴とする。

【0012】また請求項5記載の発明は、突起が直線状に形成され、且つ信号線とほぼ平行に配置されていることを特徴とする。

【0013】また請求項6記載の発明は、突起が直線状に形成され、且つ走査線とほぼ平行に配置されていることを特徴とする。

【0014】また請求項7記載の発明は、突起がジグザグ状に形成されていることを特徴とする。

【0015】また請求項8記載の発明は、突起が信号線に沿ってジグザグ状に形成されると共に走査線方向に隣接する2つの画素電極にまたがって配置されていることを特徴とする。

【0016】また請求項9記載の発明は、突起が走査線に沿ってジグザグ状に形成されると共に信号線方向に隣接する2つの画素電極にまたがって配置されていることを特徴とする。

【0017】また請求項10記載の発明は、突起が配向膜上に形成されていることを特徴とする。

【0018】また請求項11記載の発明は、突起が存在する部分の第二基板上の配向膜が除去されていることを特徴とする。

【0019】また請求項12記載の発明は、スリットが少なくとも画素電極の中央部に位置することを特徴とする。

【0020】

【発明の実施の形態】以下、本発明の実施の形態である第1実施例を図に基づいて説明する。図1は第一基板の平面図、図2は電界を印加していないときの液晶表示装置の断面図、図3は電界を印加したときの液晶表示装置の断面図である。なお、図2及び図3は図1のA-A線に沿った断面図である。

【0021】1はガラス基板の第一基板であり、この第一基板1上には走査線2と信号線3がマトリクス状に配線されている。走査線2と信号線3で囲まれる領域が1画素に相当し、この領域内に画素電極4が配置され、走査線2と信号線3の交差部には画素電極4と接続する薄膜トランジスタ5が形成される。画素電極4は中央部にスリットが形成され、このスリットは信号線と平行になっている。7は信号線3や画素電極4に積層された配向

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膜であり、垂直配向処理が施されている。

【0022】8はガラス基板の第二基板であり、第二基板8上には各画素を区切るようにブラックマトリックス9が形成され、各画素に対応してカラーフィルタ10が積層されている。カラーフィルタ10上には例えばITOなどの共通電極11が積層され、共通電極11上には垂直配向処理が施された配向膜12が積層されている。

【0023】配向膜12上には画素電極4のスリット6と信号線3に対向する位置に導電体の突起13が形成されている。図4は突起13と画素電極4の位置関係を模式的に示した図であり、図4に示すように各突起13は並列に配置されている。この突起13はITO等の共通電極11と同じ材料で形成され、共通電極11とほぼ同電位になっている。ここでは突起13と共通電極11とを同電位にするために、突起13が第二基板8の端部まで連続的に延在し、第二基板8の端部に配向膜12が存在しない領域を設け、その領域で突起13と共通電極11を接続している。なお突起13が共通電極11とほぼ同電位になればこの形態に限定するものではなく、突起13と共通電極11を第二基板8の表示領域内で電気的に接続する構成や、突起13に共通電極11と同じ電圧を直接供給する構成でもよい。

【0024】突起を低誘電率の絶縁体で形成する場合は突起を画素電極4に対向させて配置するが、突起13を導電体で形成する場合は突起13を画素電極4が存在しない部分に対向させて配置する。これは低誘電率の突起と導電体の突起13とでは突起13付近の電界の分布が異なるために、液晶分子14の倒れる方向が逆になるためである。図5は突起13付近の液晶分子14の動作を示す図である。ここで図5(a)は突起13aが導電体の場合を示し、図5(b)は突起13bが低誘電率の絶縁体のときを示す。また液晶分子14は誘電率異方性が負であり、電界が発生しないときは垂直配列している。導電体の突起13aのときは電気力線Aが突起13の表面に対して垂直方向に生じるが、低誘電率の突起13bのときは電気力線Bが突起13bの斜面に対してほぼ平行方向に生じる。そして液晶分子14は図5に示す矢印の方向に傾き、導電体の突起13aのときは突起13aの斜面とほぼ平行状態になり、低誘電率の突起13bのときは突起13bの斜面とほぼ垂直状態になる。なお導電体の突起13aを垂直配向膜12で覆った場合でも液晶分子14は突起13aを配向膜12で覆っていない場合と同様の動作をするが、電界が印加されないときに液晶分子14が配向膜12に影響されて突起13aの斜面に対してほぼ垂直に配列するため、電界を印加したときの液晶分子14の移動量が大きくなり、液晶分子14の配列状態が変化するために時間がかかってしまう。したがって導電体の突起13a上に配向膜12を積層しない方が電界の印加時に液晶分子14が短時間で確実に最適な配列状態に変化する。

【0025】信号線3に対向した突起13はスリット6に対向させた突起13よりも若干大きく形成されている。これは信号線3を挟んで隣接する画素電極4の間隔がスリット6の幅よりも広いためであるが、各突起13を同じ大きさにしても良い。突起13の大きさは、電界を印加した際に突起13の斜面からの電気力線によって突起13付近に位置する液晶分子14が決まった方向に傾斜できればよく、例えば図6に示すように突起13の幅が10 μ mの場合、高さは1 μ m以上あればよい。

【0026】第1実施例では突起13aを導電体で形成しているが、突起を液晶の誘電率よりも高い誘電率を有する誘電体で形成しても良い。高誘電率の突起の場合、突起付近の電界の分布は低誘電率の突起13bよりも導電体の突起13aの状態に近くなり、突起付近の液晶分子14の動作も導電体の突起13aのときと同様に突起の斜面と平行に倒れる。

【0027】両基板1、8間には誘電率異方性が負の液晶が封入され、画素電極4に電圧を印加しないときは液晶分子14が図2に示すように垂直配向膜7、12の影響を受けて垂直配列する。このとき突起13は配向膜12で覆われていないが、突起13付近の液晶分子14は隣接する液晶分子14の配列状態に影響されて垂直配列する。図示しない一对の偏光板で両基板1、8を挟み込み、その偏光板の透過軸が直交するように配置したとき、一方の偏光板を通過した透過光は液晶分子14によって複屈折されることなく液晶層を通過し、他方の偏光板で遮断される。

【0028】画素電極4に電圧を印加したときは図3に示すように、画素電極4と共通電極11の間に電界が発生する。図3の点線は電気力線を示す。このとき突起13が共通電極11と同電位であるため突起13の表面に対して垂直方向に電界が発生し、突起13付近の液晶分子14はその長軸が電界力線と直交するように傾斜する。また図3に示す断面で観察したときに、画素電極4の端部から斜め上方に向かって電界が発生し、画素電極4の端部付近の液晶分子14はその長軸が端部からの電気力線と直交するように傾斜する。このとき突起13付近の液晶分子14と画素電極4の端部付近の液晶分子14は同一方向に傾斜し、この傾斜した液晶分子14の影響を受けて隣接する液晶分子14も同一方向に傾斜する。一对の偏光板の透過軸を傾斜した液晶分子14の長軸方向と平行にならないように配置すると、一方の偏光板を通過した透過光は液晶分子14によって複屈折され他方の偏光板を通過する。この傾斜した液晶分子14の長軸方向に対して偏光板の透過軸を45度傾けて配置したとき、液晶分子14による複屈折の作用が最も大きくなるため、効率良く白表示ができる。液晶分子14は突起13の斜面とほぼ平行に傾斜するので、突起13を境にして液晶分子14の傾斜方向が逆になる。したがって画素内には液晶分子14の傾斜方向の異なる複数のドメ

インが存在し、互いに視野角特性を補償し合っている。

【0029】このように導電体の突起を設けたので、画素内に複数のドメインを発生させる構成でありながら、電圧降下を防止でき且つ不純物イオンが集中して付着することを防止できる。

【0030】次に第2実施例を図7に基づいて説明する。図7は画素電極4と突起16との位置関係を示す模式図であり、画素電極4のスリット15と突起16の形状以外は第1実施例と同じ構成をしている。この画素電極4の中央部分に走査線2と平行なスリット15が形成され、突起16はスリット15及び走査線2と対向する位置に形成される。この突起16も導電体で配向膜12上に形成され、第二基板8の端部まで連続的に延在して配向膜12の存在しない部分で共通電極11と電気的に接続されている。そして画素電極4と共通電極11の間に電界が発生すると突起16を境にして液晶分子14が逆方向に傾斜し、画素内に複数のドメインを形成する。

【0031】次に第3実施例を図8に基づいて説明する。図8は画素電極4と突起18との位置関係を示す模式図であり、画素電極4のスリット17と突起18の形状以外は第1実施例と同じ構成をしている。この導電体の突起18はジグザグ状に形成され、信号線3に沿って第二基板8の端まで連続的に延在している。また突起18は走査線2方向に隣り合う2つの画素電極4にまたがって配置され、各突起18は平行に並んでいる。画素電極4には突起18と対応する位置にスリット17が形成されている。そして画素電極4と共通電極11の間に電界が発生すると突起18を境にして液晶分子14が逆方向に傾斜し、画素内に複数のドメインを形成する。このとき1画素を観察すると、1画素内には平行に並んだ2辺の突起18aと、その突起18aと異なる方向に向き且つ互いに平行に並んだ2辺の突起18bが存在する。つまり1画素内にそれぞれ異なる方向に向いた2組の突起18a、18bが存在することになり、各1組の突起18の間で液晶分子14が逆方向に傾斜して2つのドメインを形成するため、1画素内に4つのドメインを形成することができ、広視野角な液晶表示装置を実現できる。

【0032】この実施例では突起18を信号線3に沿って配置したが、走査線2に沿って配置する構成でもよい。その場合、突起は信号線3方向に隣り合う2つの画素電極4にまたがって配置され、各突起は平行に並べられる。

【0033】次に第4実施例を図9に基づいて説明する。図9は液晶表示装置の断面図であり、第1実施例の図2に対応する。第4実施例は第1実施例と共通電極11と突起19の接続の仕方が異なるが、その他の構成は第1実施例と同じである。第4実施例は突起19が位置する部分の配向膜12を除き、共通電極11上に導電体の突起19を形成している。このとき突起19が確実に

共通電極11に接続できるため、突起19が共通電極11と同電位になる。この突起19の形成の仕方は、第二基板8上に共通電極11を形成した後に配向膜12を積層し、突起19が位置する部分だけ配向膜12を除去し、その後に突起19を形成する。この場合、突起19等を形成する際のマスクずれを考慮して、若干広く配向膜12を除去する必要がある。他の形成の仕方として、共通電極11上に先に突起19を形成し、共通電極11及び突起19を配向膜12で覆った後に突起19の部分のみ配向膜12を除去しても良い。このとき配向膜12の積層状態に関係なく、突起19は確実に共通電極11に接続され、且つ適正な形状のものが形成できるため、配向膜12を除去する部分を最小限にすることができ、この突起19は画素電極4のスリット6及び信号線3に対応して配置されるが、全ての突起19が共通電極11に接触しているため、第二基板8の端部まで連続的に延在させなくても部分的に分割して設けても良い。そして画素電極4に電圧を印加したときは突起19付近の液晶分子14は第1実施例と同様に動作し、1画素内に複数のドメインを形成する。

【0034】以上のように本発明では共通電極側に突起を形成したので、画素電極と共通電極の間に電界が発生した際に各画素内に複数のドメインを形成することができ、広視野角な液晶表示装置ができる。さらに突起を導電体で形成しているので突起が共通電極と同電位になり、不純物イオンが突起に集中的に吸着することを防止でき、また画素内の一部分に低誘電率の突起が存在するときに生じる電圧降下を防止でき、画素電極と共通電極の間に均一な電界を発生させることできる。

【0035】なお、実施例では導電体の突起の場合で説明したが、突起を液晶の誘電率よりも高い誘電率を有する誘電体で形成してもよく、この場合も導電体の突起と同じ効果を得られる。また、本発明の突起の場合、突起は画素電極の端部付近に対向して配置されればよく、実施例以外の形態を取ることも可能である。

【0036】

【発明の効果】本発明によれば、画素内に複数のドメインを形成するように突起を設けた場合でも、突起に不純物イオンが集中的に付着することを低減でき、焼付きを現象を防止できる。また突起に起因する電圧降下を減少させることができ、良好な表示を得ることができる。

【図面の簡単な説明】

【図1】本発明の第1実施例である液晶表示装置の第一基板の平面図である。

【図2】電界を印加していないときの液晶表示装置の断面図である。

【図3】電界を印加したときの液晶表示装置の断面図である。

【図4】第1実施例である液晶装置の画素電極と突起との位置関係を示した模式図である。

【図5】電圧を印加した際の突起付近に位置する液晶分子の動作を説明する図である。

【図6】第1実施例の突起の拡大断面図である。

【図7】第2実施例である液晶表示装置の画素電極と突起との位置関係を示した模式図である。

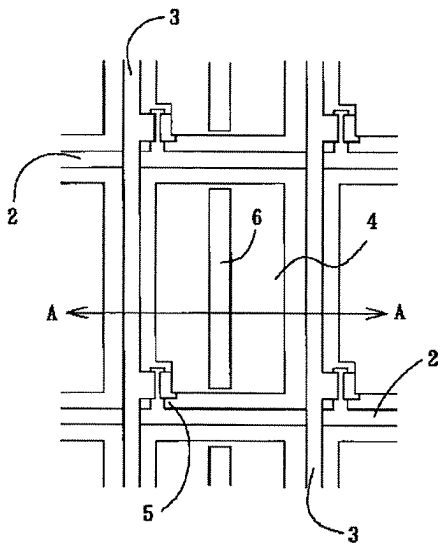
【図8】第3実施例である液晶表示装置の画素電極と突起との位置関係を示した模式図である。

【図9】第4実施例である液晶表示装置の電界を印加していないときの断面図である。

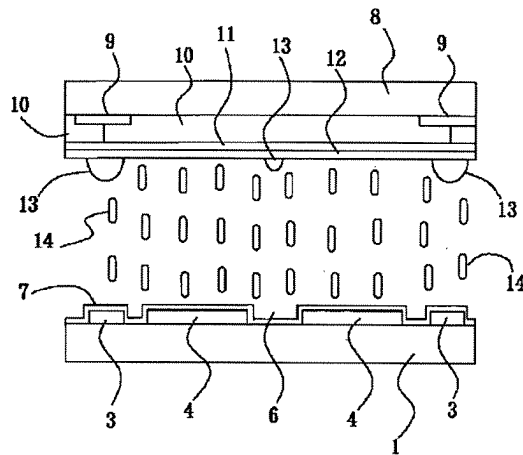
【符号の説明】

- * 1 第一基板
- 2 走査線
- 3 信号線
- 4 画素電極
- 6、15、17 スリット
- 7、12 配向膜
- 8 第二基板
- 11 共通電極
- 13、16、18、19 突起
- * 10 14 液晶分子

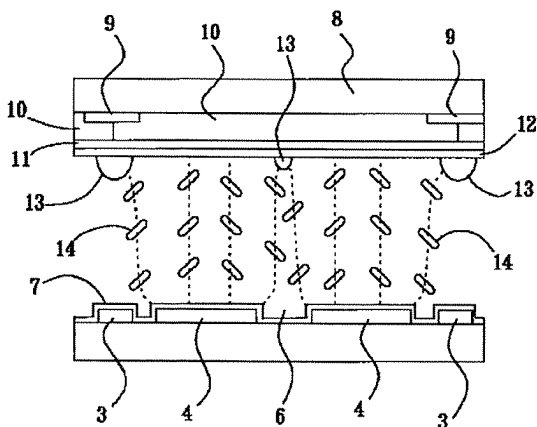
【図1】



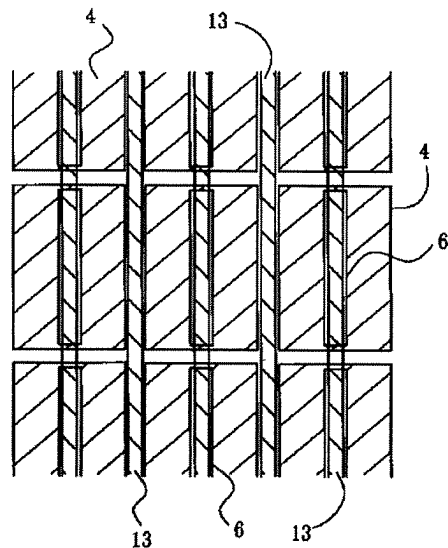
【図2】



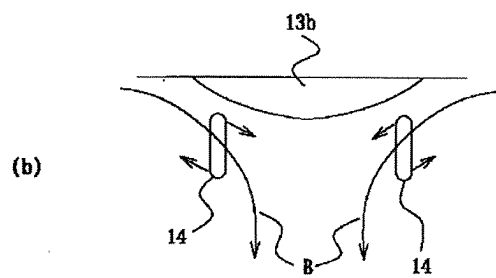
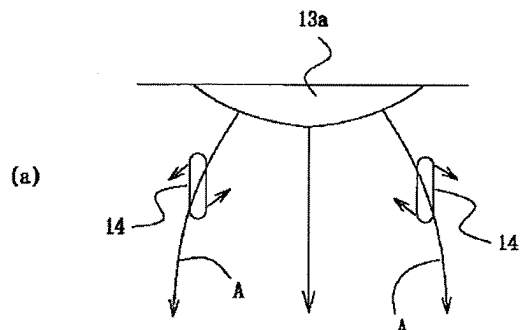
【図3】



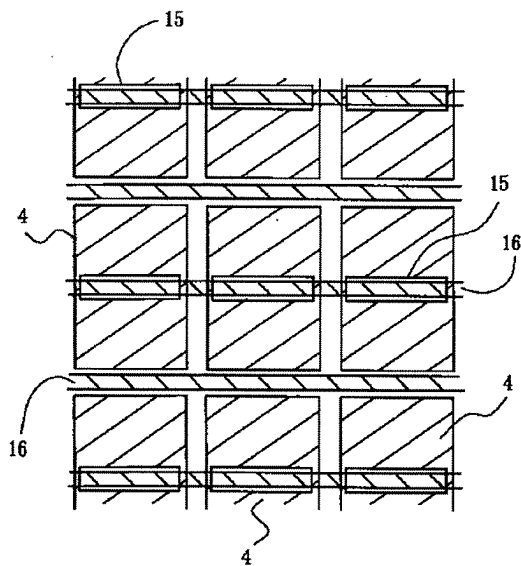
【図4】



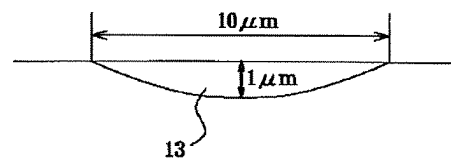
【図5】



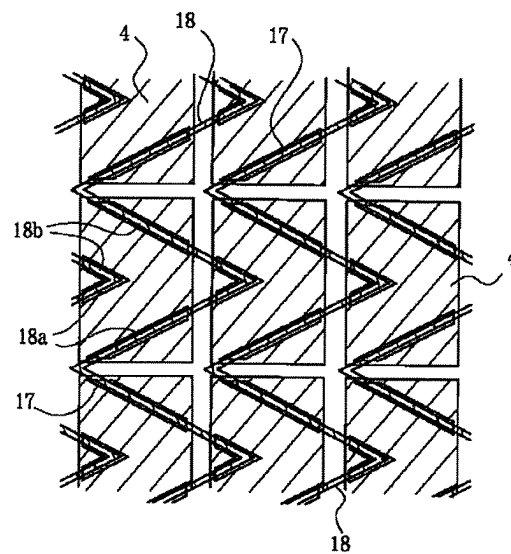
【図7】



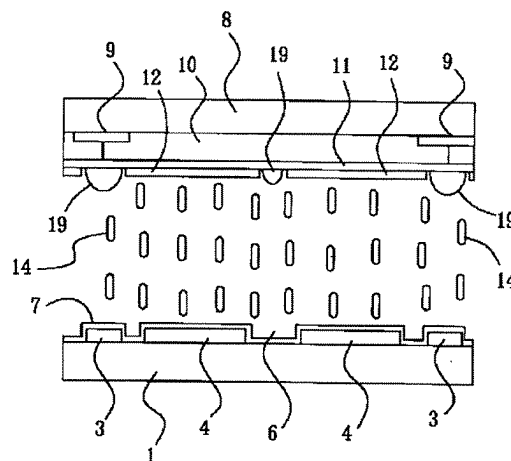
【図6】



【図8】



【図9】



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